CLAIMS:

What is claimed is:

1. A diagnostic system for plasma processing, said diagnostic system comprising:

a multi-modal resonator;

a power source, including a Gunn diode voltage controlled oscillator (VCO), coupled to said multi-modal resonator;

a detector coupled to said multi-modal resonator; and

a controller coupled to said power source and said detector, wherein said controller provides at least one function, said at least one function including at least one of a Gunn diode voltage monitor, a Gunn diode current monitor, a varactor voltage monitor, a detector voltage monitor, a varactor voltage control, a varactor voltage sweep control, a resonance lock-on control, a graphical user control, and an electron density monitor.

2. The diagnostic system as recited in claim 1, wherein said controller further provides a man-machine interface (MMI) for performing said at least one function.

3. The diagnostic system as recited in claim 1, wherein said controller is further coupled to a remote controller, and said controller permits remote control of said controller using said remote controller.

4. The diagnostic system as recited in claim 3, wherein said remote controller provides a remote man-machine interface (MMI) for remotely performing said at least one function provided by said controller.

5. The diagnostic system as recited in claim 4, wherein said remote man-machine interface comprises a graphical user interface (GUI).

6. The diagnostic system as recited in claim 4, wherein said man-machine interface comprises executing software on said remote controller.

7. The diagnostic system as recited in claim 2, wherein said MMI displays at least one of a Gunn diode voltage, a Gunn diode current, a varactor voltage, and a detector voltage.

8. The diagnostic system as recited in claim 2, wherein said varactor voltage control function provides the capability for varying the varactor voltage on said Gunn diode VCO using said MMI.

9. The diagnostic system as recited in claim 2, wherein said varactor voltage sweep function provides the capability for automatically varying the varactor voltage on said Gunn diode VCO using said MMI.

10. The diagnostic system as recited in claim 9, wherein said automatically varying the varactor voltage on said Gunn diode VCO comprises activating a sweep generator packaged in said controller using said MMI.

11. The diagnostic system as recited in claim 2, wherein said resonance lock-on function comprises activating a lock-on circuit packaged in said controller, setting a varactor voltage set-point, and activating said varactor voltage set-point.

12. The diagnostic system as recited in claim 5, wherein said graphical user interface provides a setup panel for presenting a plurality of setup parameters.

13. The diagnostic system as recited in claim 12, wherein said plurality of setup parameters comprises at least one of a minimum varactor diode sweep voltage, a maximum varactor diode sweep voltage, a dither amplitude, and a varactor voltage set point.

14. The diagnostic system as recited in claim 5, wherein said graphical user interface provides a data directory panel, said data directory panel

permits setting a directory location for storing data acquired using said remote man-machine interface.

15. The diagnostic system as recited in claim 5, wherein said graphical user interface provides a graph panel, said graph panel permits at least one of setting a data scale factor, setting a data file name, performing a print action, performing a copy action, and performing a scale action.

16. The diagnostic system as recited in claim 5, wherein said graphical user interface provides a display panel for presenting at least one data parameter.

17. The diagnostic system as recited in claim 16, wherein said data parameter includes a Gunn diode voltage, a Gunn diode current, a varactor diode voltage, and a detector voltage.

18. The diagnostic system as recited in claim 16, wherein said graphical user interface further provides a plot panel for selecting said at least one data parameter.

19. The diagnostic system as recited in claim 5, wherein said graphical user interface provides a mode panel for selecting at least one of a control function mode and a data acquisition mode.

20. The diagnostic system as recited in claim 19, wherein said control function modes comprises at least one of a varactor voltage sweep function and a resonance lock-on function.

21. The diagnostic system as recited in claim 19, wherein said data acquisition mode comprises at least one of enabling data storage to a data file and disabling data storage to a data file.

22. The diagnostic system as recited in claim 19, wherein said graphical user interface provides an action mode, said action mode permits an operator to execute said control function mode.

23. The diagnostic system as recited in claim 19, wherein said graphical user interface provides a lock-on panel for setting at least one data acquisition parameter.

24. The diagnostic system as recited in claim 23, wherein said data acquisition parameters include a sample rate, a sample duration, and a sample mode.

25. The diagnostic system as recited in claim 1, wherein said controller further provides a graphical user interface (GUI) for performing said at least one function.

26. A method of controlling a diagnostic system, said diagnostic system comprising a multi-modal resonator to produce a cavity resonance, a power source to produce an output frequency, a detector to produce a transmission signal, and a controller coupled to said power source and said detector, said method comprising:

activating said controller;

selecting a varactor voltage control in order to control a varactor voltage of said power source;

selecting a detector voltage monitor in order to monitor said transmission signal from said detector; and

adjusting said varactor voltage for said power source using said controller.

27. The method as recited in claim 26, wherein said controller provides a man-machine interface for performing at least one of setting said control function, setting said monitor function, and adjusting said varactor voltage.

28. The method as recited in claim 26, wherein said controller provides a graphical user interface for performing at least one of setting said control function, setting said monitor function, and adjusting said varactor voltage.

29. A method of controlling a diagnostic system, said diagnostic system comprising a multi-modal resonator to produce a cavity resonance, a power source to produce an output frequency, a detector to produce a transmission signal, and a controller coupled to said power source and said detector, said method comprising:

activating said controller;

selecting a varactor voltage sweep control in order to automatically control a varactor voltage of said power source;

coupling said varactor voltage to a display; and

coupling said transmission signal from said detector to said display.

30. The method as recited in claim 29, wherein said display comprises at least one of a computer, a digital signal processor, and an oscilloscope.

31. The method as recited in claim 29, wherein said controller provides a man-machine interface for performing said setting said control function.

32. The method as recited in claim 29, wherein said controller provides a graphical user interface for performing said setting said control function.

33. A method of controlling a diagnostic system, said diagnostic system comprising a multi-modal resonator to produce a cavity resonance, a power source to produce an output frequency, a detector to produce a transmission signal, and a controller coupled to said power source and said detector and configured to provide a lock-on circuit for receiving said transmission signal from said detector and locking said output frequency of said power source to said cavity resonance of said multi-modal resonator, said method comprising:

activating said controller;

selecting a resonance lock-on function;

selecting a varactor voltage of said power source; and

locking said output frequency of said power source to said cavity resonance of said multi-modal resonator by activating a varactor voltage set-point using said controller.

34. The method as recited in claim 33, wherein said method further comprises the step of:

measuring an electron density in said multi-modal resonator, wherein said measuring said electron density comprises the steps of:

recording said varactor voltage corresponding to said locking said output frequency of said power source to said cavity resonance of said multi-modal resonator;

determining a difference between said varactor voltage with plasma in said multi-modal resonator and said varactor voltage without plasma in said multi-modal resonator; and

computing said electron density from said difference.

35. The method as recited in claim 33, wherein said controller provides a man-machine interface for setting said control function, setting said varactor voltage set-point, and activating said varactor voltage set-point.

36. The method as recited in claim 33, wherein said controller provides a graphical user interface for setting said control function, setting said varactor voltage set-point, and activating said varactor voltage set-point.

37. A method of controlling a diagnostic system, said diagnostic system comprising a multi-modal resonator to produce a cavity resonance, a power source to produce an output frequency, a detector to produce a transmission signal, a controller coupled to said power source and said detector, and a remote controller coupled to said controller and configured to provide a remote man-machine interface, said method comprising:

activating said controller;

activating said remote man-machine interface;

selecting a varactor voltage sweep control; and

activating said varactor voltage sweep control using default settings.

38. The method as recited in claim 37, wherein said method further comprises modifying said default settings prior to activating said varactor voltage sweep function.

39. The method as recited in claim 38, wherein said modifying said default settings comprises modifying at least one of a minimum varactor diode voltage, a maximum varactor diode voltage, a data directory for storing acquired data, a scale, a plot variable, and a data acquisition mode.

40. A method of controlling a diagnostic system, said diagnostic system comprising a multi-modal resonator to produce a cavity resonance, a power source to produce an output frequency, a detector to produce a transmission signal, a controller coupled to said power source and said detector and configured to provide a lock-on circuit for receiving said transmission signal from said detector and locking said output frequency of said power source to said cavity resonance of said multi-modal resonator, and a remote controller coupled to said controller and configured to provide a remote man-machine interface, said method comprising:

activating said controller;

activating said remote man-machine interface;

selecting a resonance lock-on control; and

activating said resonance lock-on control using default settings.

41. The method as recited in claim 40, wherein said method further comprises modifying said default settings prior to activating said resonance lock-on control.

42. The method as recited in claim 41, wherein said modifying said default settings comprises modifying at least one of a dither amplitude, a varactor voltage set-point, a data directory for storing acquired data, a scale, a plot variable, a sample rate, a sample duration, and a data acquisition mode.